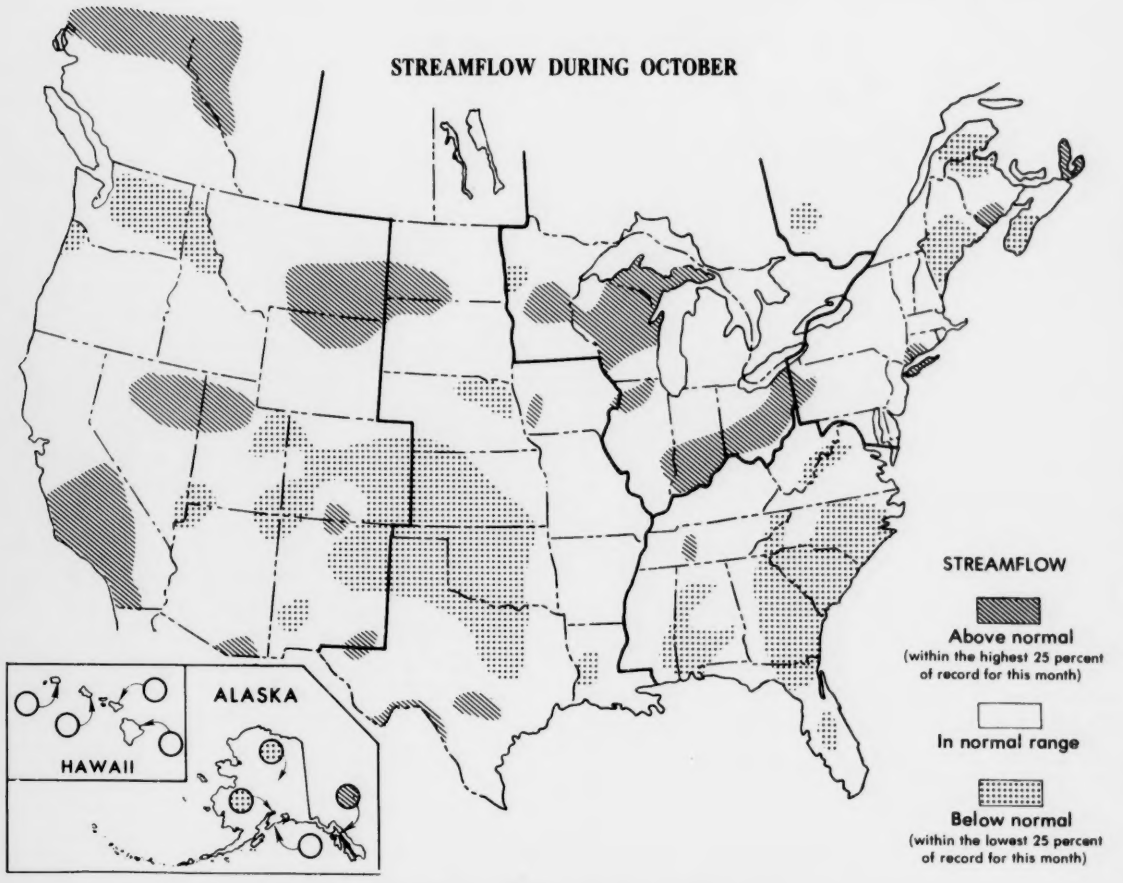
WATER RESOURCES REVIEW for OCTOBER 1978

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH



STREAMFLOW AND GROUND-WATER CONDITIONS

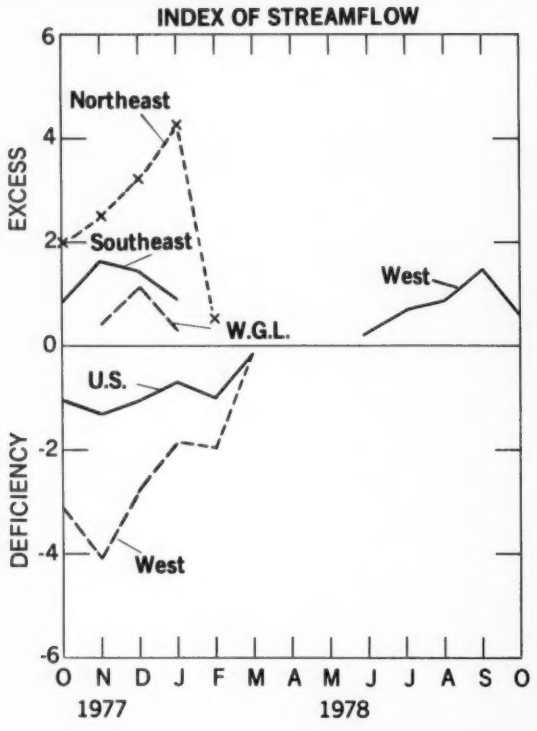
Streamflow generally increased seasonally in the Northeast Region, decreased seasonally in Alberta, Saskatchewan, Alabama, Florida, Georgia, Illinois, Indiana, Iowa, Mississippi, North Dakota, Oklahoma, South Dakota, and Wisconsin, decreased in contrast to the normal seasonal pattern of increasing flows in Idaho, North Carolina, Oregon, Virginia, Washington, and West Virginia, and was variable elsewhere.

Below-normal streamflow persisted for at least four consecutive months in parts of Nova Scotia, Colorado, Maine, Minnesota, New Mexico, and Texas, with monthly and/or daily mean flows the lowest of record for October in parts of Colorado, Kansas, and Maine.

Flows remained in the above-normal range in parts of Alberta, California, Iowa, Montana, Nevada, New Mexico, New York, North Dakota, Texas, Utah, and Wyoming. Monthly mean discharges were highest of record for October in parts of Alaska and Alberta.

Ground-water levels generally continued to decline in the Northeast and Southeast Regions. They were near average in most of New York and Pennsylvania, above average in eastern New York and southern New Jersey, but below average in most of northern New England. In the Southeast, levels were above average in most of Kentucky and much of North Carolina, but mostly below average in other States. Trends were mixed in the Western Great Lakes Region, but were generally above average. Levels declined in most of the Midcontinent Region, and levels were largely below average. In the West, level trends were mixed regionally, as were levels with respect to average.

New October high levels occurred in Kentucky and Michigan for the second consecutive month. New lows for October were recorded in Arizona, Arkansas, Idaho, Louisiana, Mississippi, New Mexico, and Texas. New alltime lows occurred in Kansas, Maine, and Tennessee.



The index of streamflow is computed by multiplying the percent of a region that is deficient or excessive by the average duration of deficiency or excess. Thus, the index of streamflow excess for the West during October decreased to a value of 0.6 when less than 15 percent of the area in the West Region was excessive for an average duration of 4 months. Areas of below-normal streamflow persist in parts of Colorado, Kansas, Minnesota, and Maine.

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

Streamflow generally decreased in New Jersey and Maryland, was variable in Pennsylvania and New York, and increased seasonally elsewhere in the region. Monthly mean flows remained in the below-normal range in parts of the Atlantic Provinces, Quebec, and Maine. Flows remained in the above-normal range on Long Island and increased into that range in parts of Connecticut and Pennsylvania. Daily mean flows were lowest of record for October in parts of Maine.

Ground-water levels continued to decline in most of New England and in the southern part of the Northeast Region. Levels in some wells in western Maine were the lowest in 20-30 years of record.

In southern Nova Scotia, monthly mean discharge increased seasonally at LaHave River at West Northfield but remained in the below-normal range for the 5th consecutive month and was only 34 percent of the October median. (See graph on page 3.) In contrast, in the northern part of the province, monthly mean flow at Northeast Margaree River at Margaree Valley increased sharply to 163 percent of median and was above the normal range. In central Nova Scotia, where monthly mean discharge of St. Mary's River at Stillwater was below the normal range and only 15 percent of median in September, mean flow increased seasonally and was within the the normal range.

In southern New Brunswick, monthly mean flow at the index station, Lepreau River at Lepreau, increased sharply to five times the flow in September and was above the normal range for the first time since April

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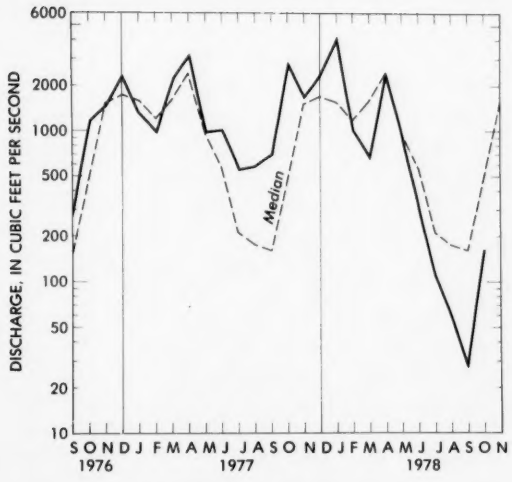


Monthly mean discharge of LaHave River at West Northfield, Nova Scotia (Drainage area, 484 sq mi; 1,254 sq km)

1978. In the northern part of the Province, monthly mean discharge at Upsalquitch River at Upsalquitch increased slightly but remained in the below-normal range for the 3d consecutive month.

South of the St. Lawrence River in eastern Quebec, monthly mean flow in Matane River at Matane increased seasonally to 41 percent of the October median flow and remained in the below-normal range. In the southwestern part of the Province, mean flow in Harricana River at Amos increased sharply but remained in the below-normal range for the 3d consecutive month. Elsewhere in the Province, mean flows were generally near or above median but within the normal range.

In southern Maine, monthly mean flow at the index station, Little Androscoggin River near South Paris (drainage area, 76.2 square miles), increased seasonally but remained in the below-normal range for the 4th consecutive month. The daily mean discharge of 1.8 cfs on the 1st was lowest for October in 57 years of record. In the central part of the State, monthly mean discharge in Piscataquis River near Dover-Foxcroft also remained in the below-normal range for the 4th consecutive month and was only 18 percent of median.

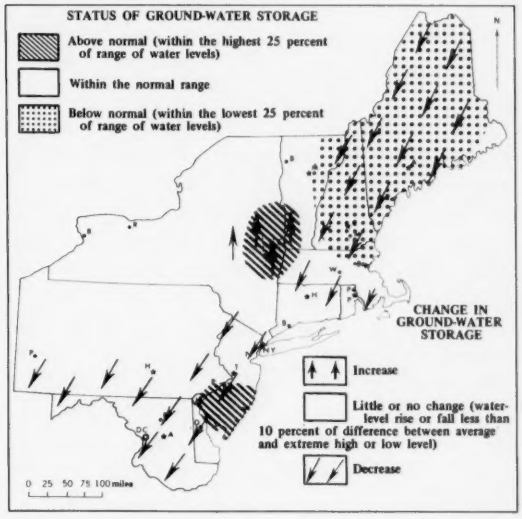
In southwestern Connecticut, monthly mean flow at Pomperaug River at Southbury increased seasonally to 214 percent of median and was above the normal range. Elsewhere in central New England, monthly mean flows at index stations in New Hampshire, Massachusetts, Rhode Island, and Vermont increased seasonally and were in the normal range.

In south-central New York, where streamflow during August and September was above the normal range at Susquehanna River at Conklin, mean flow increased seasonally but was within the normal range. On Long Island, monthly mean discharge at Massapequa Creek at Massapequa decreased seasonally but remained in the above-normal range. Elsewhere in the State, flows increased seasonally, were generally above median, but within the normal range.

In northwestern Pennsylvania, where monthly mean flow in Allegheny River at Natrona was in the normal range and 1½ times median in September, flow increased sharply as a result of above-normal precipitation and was above the normal range at 180 percent of median. Elsewhere in the State, mean flows increased in some basins and decreased in others, were generally greater than median, and within the normal range.

In Delaware, Maryland, and New Jersey, monthly mean flows at all index stations decreased but remained in the normal range and were slightly less than median flows.

Ground-water levels continued to decline in most of New England and in the southern part of the region. (See map.) Levels rose in scattered areas, including the vicinities of Boston, Mass., and Albany, N.Y. Above-average levels in the Albany area and in southern New Jersey contrasted with below-average levels in New Hampshire and Maine—the lowest in 20–30 years in some wells in western Maine.



Map shows ground-water storage near end of October and change in ground-water storage from end of September to end of October.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow decreased in all parts of the region except in west-central Tennessee where flows increased.

Monthly mean discharge remained in the below-normal range in parts of Alabama, Florida, Georgia, and South Carolina, and decreased into that range in parts of Mississippi, North Carolina, Tennessee, Virginia, and West Virginia.

Ground-water levels generally declined in the region except locally in West Virginia, Georgia, and Florida. Levels were above average in Kentucky and in much of North Carolina, and locally in West Virginia, Alabama, and Florida. A new October high level occurred in Kentucky, and new October lows were reached once again in Mississippi. An alltime low artesian level was recorded in Tennessee in the heavily-pumped Memphis area.

In the Tennessee River basin of western Tennessee, monthly mean flow of Buffalo River near Lobelville increased seasonally as a result of runoff from midmonth thunderstorms and was above the normal range for the 4th time in the past 6 months. In the extreme northeastern part of the State, mean flow of French Broad River below Douglas Dam decreased sharply, in contrast to the normal seasonal pattern of increasing flow, was below the normal range, and was only 34 percent of the median discharge for October. Elsewhere in the State, mean flows continued to decrease and remained in the normal range.

In southeastern Alabama, mean flow of Conecuh River at Brantley continued to decrease seasonally and remained below the normal range. Elsewhere in the State mean flows also continued to decrease seasonally and were less than median but were within the normal range.

In west-central Florida, monthly mean discharge of Peace River at Arcadia decreased seasonally, was only 18 percent of the October median flow, and remained in the below-normal range. In the Suwannee River basin of northeastern Florida and the adjacent area of Georgia, mean flow of Suwannee River at Branford, Fla. decreased and was in the below-normal range for the first time since August 1977. Elsewhere in the State, mean flows decreased seasonally and remained in the normal range.

In the Suwannee River basin of southern Georgia, mean flow of Alapaha River at Statenville continued to decrease seasonally, was only 20 percent of median, and remained below the normal range for the 3d consecutive month. In central and northern parts of the State, monthly mean flows of Altamaha River at Doctortown and Oconee River near Greensboro, respectively, continued to decrease and remained in the below-normal range.

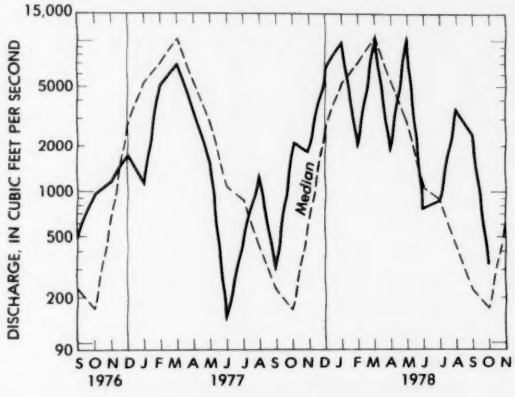
In eastern South Carolina, mean flow of Lynches River at Effingham continued to decrease and remained in the below-normal range. In the northeastern part of the State, mean flow of Pee Dee River at Peedee also decreased, and was in the below-normal range for the first time since August 1977.

In the southeastern Piedmont, and along the Piedmont-Coastal fall line of North Carolina, mean flow of Neuse River near Clayton continued to decrease and was in the below-normal range. In the Tennessee River basin in the extreme western part of the State, monthly mean flow of French Broad River at Asheville also decreased into the below-normal range, and was only 57 percent of the October median discharge.

In northern Virginia, mean flow of Rapidan River near Culpeper decreased, in contrast to the normal seasonal pattern of increasing flow, was below the normal range and only 50 percent of median. Elsewhere in the State, mean flows also decreased, contrary to the normal seasonal pattern, and were less than the October median flows but remained in the normal range.

Similarly in West Virginia, mean flows decreased in contrast to the normal pattern, were less than median, and were in the normal range except in the southeastern part of the State, where mean discharge of Greenbrier River at Alderson was below the normal range and only 29 percent of median.

In northern Kentucky, where mean flow of Licking River at Catawba was 10 times median and above the normal range in September, flow decreased sharply into the normal range but was 2 times the median discharge for October. (See graph.) In the southern part of the State, mean flow of Green River at Munfordville also decreased into the normal range but was less than the October median discharge for that station.



Monthly mean discharge of Licking River at Catawba, Ky. (Drainage area, 3,300 sq mi; 8,547 sq km)

Ground-water levels in West Virginia generally declined except in a few northeastern counties; levels were generally below average except in the northern panhandle and extreme southern parts of the State.

Levels in Kentucky generally declined but were above average in most areas. A new October high in 32 years of record was noted in the water table well in sand and gravel near Louisville, despite a slight net decline during the month. In Virginia, levels declined and were below average in all three key wells--reflecting below-average precipitation during the past 2 months. In western Tennessee, the artesian level in the key well in the "500-foot sand" near Memphis declined slightly and continued nearly 16 feet below average; it was at a new alltime low in 37 years of record, reflecting the general decline in pressure levels caused by continued heavy municipal pumping. In North Carolina, levels declined statewide; but were above average in the mountains and in the Piedmont, and below average in the Coastal Plain. Levels declined in Mississippi. New lows for October occurred in all of the observation wells measured in both the Sparta Sand and the Cockfield Formation in the Jackson Metropolitan area. Levels in most major wells in the Cretaceous aquifers in northeastern Mississippi showed significant declines, and moderate declines were noted along the Gulf Coast in the Miocene aquifers. Levels in Alabama declined but were near average. (A corrected reading for the well in Centreville indicates that the August level was near average, rather than at an alltime low, as reported in the August 1978 issue of the Review.--Ed.) Levels in the Piedmont of Georgia declined 1 to 3 feet. Trends were mixed in the principal artesian aquifer in the coastal counties. Levels held steady in the Savannah area and declined as much as 2 feet near Brunswick. Levels in the water-table aquifer were below average. In southwestern Georgia, levels declined about 2 feet. In Florida, levels declined in most areas of northern and parts of southern Florida, but rose near Pensacola in the extreme northwest and near Ocala in the central peninsular part of the State. Levels were above average at Pensacola, more than 8 feet below average near Mulberry, and 3 feet or more below average at Tallahassee, at Jacksonville, and near Tampa. Levels generally rose in southeastern Florida during October except for slight declines in a few parts of southern Dade County; they were about average to about a foot below average.

WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow decreased seasonally in Illinois, Indiana, and Wisconsin, generally increased in Ohio, and was variable elsewhere in the region. Monthly mean flows remained above the normal range in parts of all States in the region and was in the normal range in the Province of Ontario. Mean flows continued to be below the normal range in parts of Minnesota.

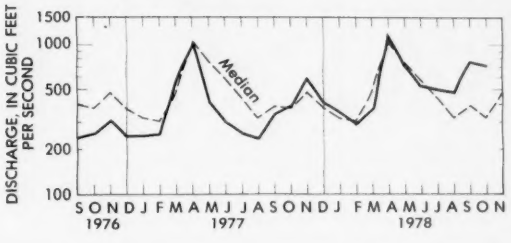
Ground-water levels rose in Michigan, held steady or rose in Indiana, declined in Illinois, and showed mixed trends elsewhere in the region. Levels were generally above average except locally in Minnesota and Michigan. New high levels for October occurred in Michigan.

In northeastern Ohio, monthly mean flow of Little Beaver Creek at East Liverpool increased seasonally, was 4 times median, and remained in the above-normal range for the 6th consecutive month and the 14th time in the past 16 months. In the central part of the State, mean flow of Scioto River at Higby also increased, remained above the normal range, and was 3 times the median flow for October.

In the western part of Michigan's Upper Peninsula, monthly mean discharge of Sturgeon River near Sidnaw decreased but, as a result of high carryover flow from September, augmented by runoff from rains early in October, mean flow remained in the above-normal range for the 3d consecutive month. In the northern part of the Lower Peninsula, mean flow of Muskegon River at Evart decreased, contrary to the normal seasonal pattern of increasing flow, was greater than median, but was in the normal range. In the southern part of the Lower Peninsula, monthly mean flow of Red Cedar River at East Lansing increased seasonally but remained in the normal range and was less than median.

In southeastern Ontario, monthly mean flow of Saugeen River near Port Elgin decreased from the above-normal flow of September and was in the normal range but was 180 percent of the October median flow. In the eastern part of the Province, mean flow of Missinaibi River at Mattice increased, as a result of runoff from rains early in October, and was 2½ times median but remained in the normal range.

In northwestern Wisconsin, high carryover flow from September, augmented by increased runoff from rains early in October, held monthly mean discharge of Chippewa River at Chippewa Falls in the above-normal range for the 4th consecutive month. In the eastern part of the State, mean flow of Oconto River near Gillett decreased seasonally but remained in the above-normal range for the 3d consecutive month. (See graph). Also in eastern Wisconsin, mean flow of Fox River at Rapide



Monthly mean discharge of Oconto River near Gillett, Wis. (Drainage area, 678 sq mi; 1,756 sq km)

(Continued on page 7.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	October 31, 1978	Monthly mean, October		October		
		1978	1977	Average 1900–75	Maximum (year)	Minimum (year)
Superior	600.80	601.00	601.39	600.96	601.93 (1951)	599.49 (1925)
(Marquette, Mich.)						
Michigan and Huron	578.88	579.00	578.38	578.26	580.45 (1973)	575.77 (1964)
(Harbor Beach, Mich.)						
St. Clair	574.00	574.12	574.10	573.22	575.35 (1973)	571.13 (1934)
(St. Clair Shores, Mich.)						
Erie	570.84	570.99	571.36	570.12	572.14 (1973)	567.95 (1934)
(Cleveland, Ohio)						
Ontario	243.90	244.15	245.03	244.31	246.33 (1945)	241.72 (1934)
(Oswego, N.Y.)						

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	October 31, 1978	October 31, 1977	Reference period 1904–78		
			October average, 1904–78	October maximum (year)	October minimum (year)
Elevation in feet above mean sea level:	4,198.40	4,198.75	4,197.6	4,204.0 (1923)	4,191.35 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1977): 102.1 (1869). Alltime low (1939–1977): 92.17 (1941).	October 30, 1978	October 31, 1977	Reference period 1939–75		
			October average, 1939–75	October max. daily (year)	October min. daily (year)
Elevation in feet above mean sea level:	94.34	98.55	94.43	97.96 (1946)	92.90 (1942)

FLORIDA

Site	October 1978		September 1978	October 1977
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	810	96	820	600
Miami Canal at Miami (southeastern Florida)	439	95	450	259
Tamiami Canal outlets, 40-mile bend to Monroe	192	33	386	550

(Continued from page 5.)
Croche Dam, near Wrightstown decreased seasonally and remained above the normal range. In western Wisconsin, monthly mean discharge of Wisconsin River at Muscoda decreased seasonally but remained in the above-normal range for the 4th consecutive month as a result of high carryover flow from September and runoff from rains early in October.

In northern Illinois, where mean flow of Rock River near Joslin was above the normal range and 2½ times median in September, monthly mean discharge decreased seasonally but remained in the above-normal range for the 6th consecutive month and remained at 2½ times median. Monthly mean flow of Pecatonica River at Freeport, tributary to Rock River, decreased into the normal range from the above-normal flow of September, but remained above median. In the southern part of the State, monthly mean flow of Skillet Fork at Wayne City also decreased and was in the normal range.

In central Minnesota, mean flow of Mississippi River near Anoka was 1½ times median and in the above-normal range. Also in the central part of the State, monthly mean discharge of Crow River at Rockford decreased sharply but remained above the normal range, as a result of high carryover flow from September, and was 4 times median. In the western part of the State, mean flow of Buffalo River near Dilworth increased, contrary to the normal seasonal pattern of decreasing flows, but was only 35 percent of median and remained in the below-normal range for the 5th consecutive month.

In southeastern Indiana, monthly mean flow of East Fork White River at Shoals decreased seasonally but remained in the above-normal range, and 6½ times median, as a result of high carryover flow from September and increased runoff from rains near mid-month. About 4 inches of rain was reported to have fallen in the central part of that basin on the 12th. In the extreme southwestern part of the State, mean flow of Wabash River, as measured at the Indiana-Illinois border at Mt. Carmel, Ill., also decreased seasonally but remained in the above-normal range for the 7th time in the past 8 months as a result of high carryover flow from September and increased runoff from rain near mid-month. Elsewhere in the State, mean flows decreased and were in the normal range.

Ground-water levels in shallow water-table wells in Minnesota rose but continued below average in the northern part of the State, and declined and continued below average in the southern part. Artesian levels in the Minneapolis-St-Paul area continued to rise and were above average in wells tapping the Prairie du Chien-Jordan aquifer and the deeper Mt. Simon-Hinckley aquifers. Levels in shallow aquifers in Wisconsin continued to rise, except in the southwestern part of the State, where they declined. Levels declined slightly in the heavily-pumped deep sandstone aquifer near Milwaukee. In Michigan, levels rose in most parts of the State; they were below average in the central part of the Lower Peninsula and above average elsewhere. In response to precipitation, some new high levels for October occurred in the western part of the Upper Peninsula, including that in the key well at Ishpeming in Pleistocene drift with 17 years of record. In Illinois, the level in the shallow index well in glacial drift at Princeton, in Bureau County, declined but was still above average. In Indiana, levels rose in the south, but held steady in the north; they were generally above average statewide. In Ohio, levels declined in the northeast but were about average; levels rose and were above normal in central Ohio.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow increased in Manitoba, decreased in Saskatchewan, Iowa, Kansas, North Dakota, Oklahoma, and South Dakota, and was variable in Arkansas, Louisiana, Missouri, Nebraska, and Texas. Monthly mean flows remained in the above-normal range in parts of Iowa, North Dakota, and Texas. Mean flows remained in the below-normal range in parts of Kansas, Nebraska, Oklahoma, and Texas, and decreased into that range in parts of Louisiana. Monthly and daily mean flows were lowest of record in parts of Kansas.

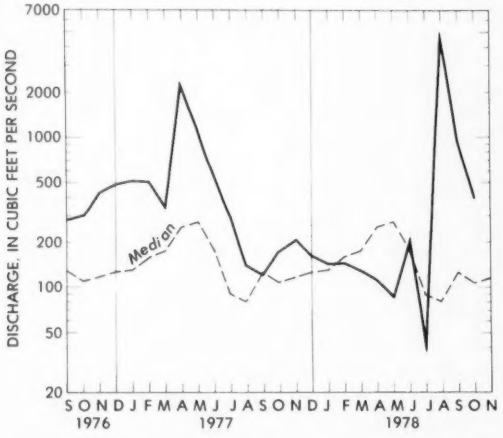
Ground-water levels generally declined in the region except for local rises in Nebraska, Iowa, Kansas, and Arkansas. Levels were below average except in western North Dakota, eastern Iowa, and locally in Louisiana and Texas. A new alltime low was reached in Kansas, and new October lows occurred in Arkansas, Louisiana, and Texas.

In northwestern Kansas, where mean flow of Saline River near Russell (drainage area, 1,502 square miles) decreased sharply, the monthly mean discharge of 1.59 cfs, and the daily mean of 1.3 cfs on the 31st, were lowest for October in 28 years of record. This was the 2d consecutive month of record-low monthly and daily mean discharges at this index station. In northeastern Kansas, mean flow of Little Blue River near Barnes decreased sharply from 1½ times median in September to 60 percent of median in October but remained within the normal range. In the southern part of the State,

monthly mean discharge of Arkansas River at Arkansas City also decreased sharply, was below the normal range, and was only 22 percent of median.

In south-central Oklahoma, monthly mean flow of Washita River near Durwood decreased sharply, was only 17 percent of the median discharge for October, and remained in the below-normal range for the 3d consecutive month.

In eastern Texas, many tributary stream channels were dry and flow in some principal streams was sustained only by releases from impoundments. Monthly mean flow of the index stream, North Bosque River near Clifton, in this area, remained below the normal range for the 9th time in the past 11 months, and was only 3 percent of the October median flow. In central Texas, mean flow of Guadalupe River near Spring Branch decreased sharply, but as a result of high carryover flow from August and September, remained in the above-normal range and was 370 percent of median. (See graph.) Mean flows also were above normal in the lower Rio Grande basin.



Monthly mean discharge of Guadalupe River near Spring Branch, Tex. (Drainage area, 1,315 sq mi; 3,406 sq km)

In west-central Louisiana, monthly mean discharge of Calcasieu River near Oberlin decreased sharply to 50 percent of median, and was below the normal range for the 6th time in the past 8 months. Mean flow of Red River at Alexandria also was below the normal range, but elsewhere in the State, monthly mean discharges were within the normal range and near or above the October median flows.

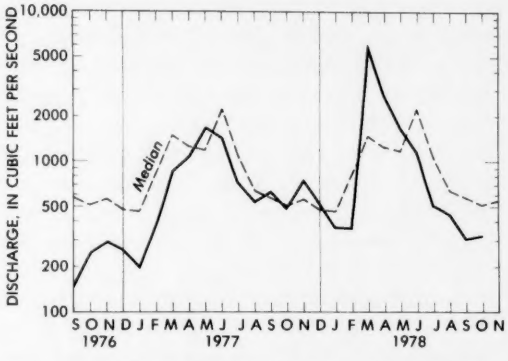
In north-central Arkansas, monthly mean flow of Buffalo River near St. Joe increased, contrary to the normal seasonal pattern of decreasing flow, and was in the normal range but was less than median for October. In the south-central part of the State, mean flow of Saline River near Rye decreased sharply from the above-normal flow of September but was in the normal range and well above the median flow for the month.

In northwestern Missouri, mean flow of Grand River near Gallatin decreased sharply from the extremely high flow of September, was 69 percent of median, and was in the normal range. In the south-central part of the State, monthly mean discharge of Gasconade River at Jerome increased seasonally but remained below median and within the normal range.

In southwestern Iowa, mean flow of Nishnabotna River above Hamburg decreased from the unusually high flow of September, remained in the above-normal range, and was 237 percent of the median flow for October. Elsewhere in the State, monthly mean flows decreased seasonally but were well above median and within the normal range at all index stations.

In central South Dakota, no flow occurred during October in Bad River near Fort Pierre. In the eastern part of the State, mean flow of Big Sioux River, as measured at Akron, Iowa, decreased seasonally, was less than median, and remained in the normal range for the 6th consecutive month.

In southwestern Nebraska, the Republican River was reported to be dry upstream from both Swanson Lake and Harlan County Lake at monthend. In the Panhandle area of northwestern Nebraska, mean flow of Niobrara River above Box Butte Reservoir decreased, contrary to the normal seasonal pattern of increasing flow, but was in the normal range and near median for October. Also in the Panhandle area, flow of North Platte River was reported to be in the normal range. In the eastern part of the State, monthly mean discharge of Elkhorn River at Waterloo increased, as a result of runoff from rains late in the month, but remained below the normal range and was only 63 percent of median. (See graph.)



Monthly mean discharge of Elkhorn River at Waterloo, Nebr. (Drainage area, 6,900 sq mi; 17,900 sq km)

In southwestern North Dakota, monthly mean flow of Cannonball River at Breien decreased seasonally but

remained above the normal range for the 7th time in the past 8 months as a result of high carryover flow from September. In the eastern part of the State, mean flow of Red River of the North at Grand Forks decreased seasonally and was less than median but remained within the normal range.

In southeastern Saskatchewan, monthly mean flow of Qu'Appelle River near Lumsden also decreased seasonally, was less than median and remained in the normal range.

In southern Manitoba, monthly mean discharge of Waterhen River below Waterhen Lake increased slightly contrary to the normal seasonal pattern of decreasing flow, but remained below median and within the normal range for the 25th consecutive month. The level of Lake Winnipeg at Gimli averaged 714.68 feet above mean sea level for the month, 0.13 foot higher than last month, 2.94 feet higher than last October, 1.10 feet higher than the long-term average for October, and 1.73 feet lower than the maximum October mean for the period of record. The record of Lake Winnipeg levels began in 1913 at Winnipeg Beach.

Ground-water levels in North Dakota declined slightly statewide, and were below average in the east but above average in the west. Levels in Nebraska declined slightly and were below average in the western third of the State, and rose slightly and were above and below average in the eastern two-thirds. In Iowa, levels in shallow water-table wells declined except in the south-central part of the State, where they rose in response to local precipitation. Levels were above average except in the extreme northeast and southwest. Levels in Kansas declined except in the key well in the equus beds in Harvey County in the south-central part of the State. A new alltime low in 31 years of record, for the fourth consecutive month, was reached in the well at Colby, in Thomas County, in the northwest Kansas high plains—reflecting continued heavy pumping for irrigation in the Ogallala Formation. In Arkansas, the level in the shallow Quaternary aquifer in the rice-growing area in the east-central part of the State rose slightly and was in the range that has prevailed since 1961. The level in the deep Sparta Sand aquifer held steady, but was about 85 feet below average, and at a new October low in 12 years of record. In the industrial aquifer of central and southern Arkansas, the level in the key well at Pine Bluff declined slightly to a new October low in 12 years of record, and was nearly 20 feet below average. At El Dorado, the level held steady but was more than 16 feet below average. In Louisiana, levels in wells in most aquifers in the southeast declined and were near seasonal lows. Levels in some wells in the Gonzales-New Orleans aquifer and in the "1,200-foot sand" of the Baton Rouge area, however, rose slightly by the end of the month. In southwestern Louisiana, levels declined slightly in wells screened in the Chicot "500-foot sand" near the pumping center of the Lake Charles industrial area. Elsewhere in southwestern Louisiana, levels rose in most of the key wells in the Chicot and Evangeline aquifers. Despite a recovery of nearly 20 feet since July of the level in the key well in Iowa, La., in the rice irrigation area, a new low for October was recorded in 38 years of record. In northern Louisiana, levels in most wells in the Sparta Sand and in the Miocene aquifers, away from pumping centers, continued to decline. Levels in wells in the Cockfield, Wilcox, terrace, and alluvial aquifers were near normal fall lows. In Texas, levels in key wells in the Edwards Limestone declined but were above average at San Antonio, and declined and were below average at Austin. Levels in wells in the Evangeline aquifer at Houston declined and were below average, as did the levels in wells in the bolson deposits at El Paso, where a new October low was reached in 21 years of record.

WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

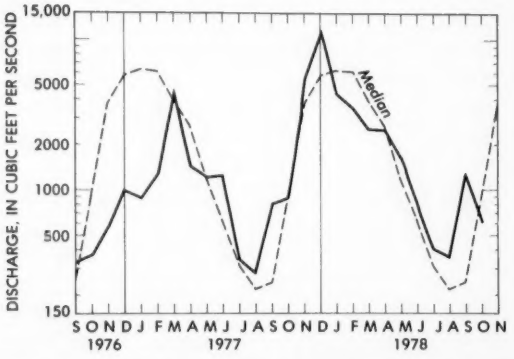
Streamflow was variable in Arizona, New Mexico, Nevada, Utah, and Wyoming, and generally decreased elsewhere in the region. Above-normal streamflow persisted in parts of Alberta, British Columbia, California, Nevada, New Mexico, Montana, Utah, and Wyoming. Flows remained in the below-normal range in parts of Arizona, Colorado, New Mexico, and Utah, and decreased into that range in parts of Idaho, Oregon, and Washington. Monthly mean discharges were lowest of record for October in parts of Colorado and highest of record for the month in parts of Alberta.

Ground-water levels generally rose but were mostly below average in Utah and New Mexico, declined but were above and below average in Washington and Montana, and showed mixed trends and mixed levels with respect to average in other States in the region. New lows for October were recorded in Idaho, Arizona, and New Mexico.

In Alberta, the monthly mean discharge of 7,130 cfs at Athabasca River at Hinton (drainage area, 3,780 square miles) was highest of record for October and marked the 2d consecutive month of above-normal flow at that site. In the southwestern part of the Province, mean flow in Bow River at Banff also decreased seasonally and remained in the above-normal range.

In northwestern British Columbia, where mean flow in Skeena River at Usk was below the normal range and only 75 percent of median in September, flow increased sharply and was above the normal range for the first time since April 1977. Elsewhere in the Province, mean flows generally decreased seasonally, were slightly below median, and within the normal range.

In Washington, mean flows decreased, contrary to the normal seasonal pattern of increasing flows and were below the normal range in Skykomish River near Gold Bar and Spokane River at Spokane, a sharp contrast from the above-normal streamflow in September. In the southwestern part of the State, where monthly and daily mean discharges were highest of record during September at Chehalis River near Grand Mound, mean flow decreased to only 67 percent of median but was within the normal range. (See graph.)



Monthly mean discharge of Chehalis River near Grand Mound, Wash. (Drainage area, 895 sq mi; 2,318 sq km)

In northern Idaho, mean flow in Clearwater River at Spalding decreased 67 percent, contrary to the normal seasonal increase of 26 percent from September to October, and was below the normal range following 3 consecutive months of above-normal flows. Elsewhere in the State, monthly mean flows also decreased but were generally in the normal range. Reservoir storage for irrigation in southern Idaho was above average.

In northwestern Montana, monthly mean discharges at index stations decreased unseasonally from the above-normal range in September and were within the normal range in October. In the southern part of the State, monthly mean flow in Yellowstone River at Billings decreased seasonally to 134 percent of median but remained in the above-normal range for the 4th consecutive month. Monthly mean flow at the index station upstream at Corwin Springs returned to the normal range following 3 consecutive months of above-normal streamflow.

In northern Wyoming, monthly mean flow in Tongue River near Dayton continued to decrease seasonally but remained in the above-normal range for the 5th consecutive month. In the southern part of the State, mean flows increased seasonally and were generally less than median but within the normal range.

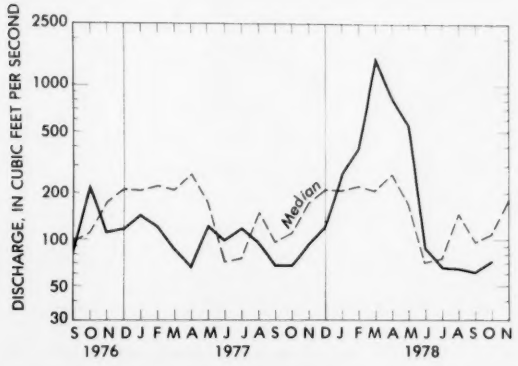
In northwestern Utah, mean flow in Big Cottonwood Creek near Salt Lake City continued to decrease seasonally, was nearly 1½ times median, and remained in the above-normal range for the 5th consecutive month. In the eastern part of the State, monthly mean discharges at Whiterocks River near Whiterocks and Green River at Green River decreased and were below the normal range for the first time since May 1978 and February 1978, respectively. In the extreme southeastern part of the State, flow in San Juan River near Bluff increased to 36 percent of median but remained in the below-normal range for the 3d consecutive month.

East of the Continental Divide in central Colorado, the monthly mean discharge of 8.4 cfs in Bear Creek at Morrison (drainage area, 164 square miles) was lowest for the month in 63 years of record. Flows at this index station have been below the normal range for 5 consecutive months. Also in central Colorado, but west of the Divide, monthly mean flow in Roaring Fork River at Glenwood Springs decreased, in contrast to the normal seasonal pattern of increasing flows, and was below the normal range. In the southwestern part of the State, monthly mean flow in Animas River at Durango continued to decrease seasonally and remained in the below-normal range for the 3d consecutive month.

In southeastern New Mexico, monthly mean discharge in Delaware River near Red Bluff decreased seasonally but remained in the above-normal range as a result of high carryover flow from September and was nearly 11 times the October median discharge. In the northern part of the State, where monthly mean discharge in Rio Grande below Taos Junction Bridge, near Taos was below the normal range and 80 percent of median in September, mean flow increased sharply and was above the normal range. In the remainder of the State, streamflow decreased seasonally in Pecos River near Pecos and increased in Gila River near Gila but remained in the below-normal range at those sites for 3 and 4 consecutive months, respectively.

In southern Arizona, where monthly mean discharge in San Pedro River at Charleston was below the normal range and only 26 percent of median in September, mean flow increased, contrary to the normal seasonal pattern of decreasing flows, and was above the normal range at over 3 times median. Elsewhere in the State, mean flows increased at some index stations and decreased at others but were generally in the normal range.

In southern Nevada and the adjacent areas of Arizona and Utah, monthly mean flow in Virgin River as measured at Littlefield, Ariz., increased seasonally but remained in the below-normal range for the 3d consecutive month. (See graph.) In north-central Nevada, monthly mean discharge in Humboldt River at Palisade increased seasonally and remained in the above-normal range.



Monthly mean discharge of Virgin River at Littlefield, Ariz. (Drainage area, 5,090 sq mi; 13,180 sq km)

In north-coastal California, where monthly and daily mean flows were highest of record in Smith River near Crescent City during September, streamflow decreased sharply to only 65 percent of median in October as a result of little or no precipitation and was in the normal range. In the southern Sierra Nevada west slope, streamflow remained high, especially in the Kings, Kaweah, and Kern River basins, as a result of runoff from the record accumulation of snow last winter and high carryover flow from September rains. For example, monthly mean discharge in Kings River above North Fork, near Trimmer, decreased seasonally from the record high flows during September but remained in the above-normal range for the 6th consecutive month. In the south-coastal part of the State, monthly mean flow in Arroyo Seco near Pasadena decreased but remained in the above-normal range for the 11th consecutive month. Combined contents of 10 major reservoirs in northern California were 122 percent of average and 3½ times that of a year ago.

In Oregon, where monthly mean flows at all index stations were in the above-normal range in September, and where normal October flows are greater than those of September, flows decreased unseasonally and were generally in the normal range. However, in extreme northwestern Oregon, where monthly mean flow near Tillamook, in the coastal basin of Wilson River, was nearly 5 times median during September, flow decreased sharply to only 30 percent of median and was below the normal range.

Contents of the Colorado River Storage Project decreased 445,470 acre-feet during the month.

Ground-water levels in Washington declined in both eastern and western wells; the level in the well in the Spokane Valley was slightly above average, and that in the Sumas well was nearly 3 feet below average. In Idaho, the level in the well penetrating the sand and gravel aquifer in the Boise Valley declined but was slightly above average. Levels in the key wells representative of the Snake River Plain aquifer reached new monthend lows in the eastern, south-central, and southwestern part and were below average in the western part. The level representative of the alluvial aquifer underlying the Rathdrum Prairie, northern Idaho, held steady but continued below average. In Montana, the level declined and was below average in the Stahl well at Missoula; the level declined but was above average in the Hamilton Fairgrounds well. In southern California, the level in the well in the coastal plain of the Los Alamitos area in Orange County declined and was below average; the level in the well in Baldwin Park in the San Gabriel River basin, Los Angeles County, declined and continued below average. In Santa Barbara County, the levels rose and continued above average in the Lompoc area of Santa Ynez Valley, and rose but continued below average in the alluvial plain of Santa Maria Valley. In Nevada, the level in the Paradise Valley well declined but was above average; levels rose and were above average in Steptoe Valley, and rose but were below average in Truckee Meadows. In Utah, levels generally rose statewide, but continued below average except in the Blanding area, where the level was more than a foot above average. In Arizona, levels declined in two index wells and increased in three others. A new October low was reached, in 11 years of record, in the City of Tucson No. 2 observation well. In New Mexico, levels rose in three key wells and held steady in a fourth; all were below average. A new October low in 41 years of record was reached, despite a slight net rise, in the Dayton well in Eddy County in the southern part of the Roswell basin.

ALASKA

Streamflow decreased seasonally at all index stations in the State except Gold Creek near Juneau (drainage area, 9.76 square miles), in the southeast coastal area, where monthly mean discharge increased from 82 cfs in September (in the below-normal range), to 279 cfs in October, more than twice the monthly median, above the normal range, and highest for October since records

began in 1946. By contrast, flow of Chena River at Fairbanks, in east-central Alaska, decreased sharply, was only 61 percent of the October median, and remained in the below-normal range for the 6th consecutive month. In Little Susitna River basin, in south-central Alaska, where monthly mean flows have decreased steadily since June, and monthly mean discharges during August and September were below the normal range, flow continued to decrease and remained in the below-normal range. Elsewhere in the State, monthly mean flows in Tanana River at Nenana and Kenai River at Cooper Landing decreased and were in the normal range.

Ground-water levels in wells tapping the confined aquifer system in the Anchorage area generally rose as a result of decreased pumping. Water levels in wells near Cook Inlet generally remained unchanged for the month.

HAWAII

Streamflow generally decreased, contrary to the normal seasonal pattern of increasing flows, and was in the normal range. Monthly mean discharges of Honopou Stream near Huelo, Island of Maui, and East Branch of North Fork Wailua River near Lihue, Island of Kauai, decreased sharply and were in the normal range, following 4 consecutive months of mean flows in the above-normal range. On the island of Oahu, where mean flow of Kalihi Stream near Honolulu was above the normal range in August and September, monthly mean discharge also decreased into the normal range, and was less than median for the first time in 6 months. Mean flow of Waiakea Stream near Mountain View, Island of Hawaii, also decreased, remained in the normal range for the 3d consecutive month, and was less than median for the first time in 5 months. On Guam, monthly mean flow of Ylig River near Yona decreased sharply and was below the normal range after 4 consecutive months of mean discharge within the normal range. On the 24th, typhoon Rita passed 65 miles south of Guam with a maximum wind speed of 190 miles per hour and caused major wind damage on the island, but did not cause major flood damage.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile (sq mi) = 259 hectares = 2.59 square kilometers (sq km)
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters
1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters
1 million gallons (mg) = 3,785 cubic meters = 3.785 million liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR OCTOBER ON SIX LARGE RIVERS

The table at right shows dissolved-solids and temperature data for October at six stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). NASQAN, as established by the U.S. Department of the Interior, Geological Survey, is designed to describe the water quality of the Nation's streams and rivers on a systematic and continuing basis, so as to meet many of the information needs of those involved in national or regional water-quality planning and management.

"Dissolved solids," as described in several columns of the table, are minerals dissolved in water and usually consist predominantly of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. These same minerals are among the most common components of the Earth's solid rocks and minerals, but gradually erode and at least partly dissolve as a part of natural weathering processes. Collectively these and other dissolved minerals constitute the dissolved-solids concentration expressed in milligrams per liter (mg/L) or the generally equivalent expression, parts per million (parts of dissolved matter in one million parts of water, by weight). Values of dissolved solids are convenient for comparing the quality of water from one time to another and from one place to another. Most drinking water contains between 50 and 500 mg/L of dissolved solids.

"Dissolved-solids discharge," expressed in tons per day, represents the total daily amount of dissolved minerals carried by the stream and is calculated by multiplying the dissolved-solids concentration (in mg/L) by the stream discharge (in cfs; times a unit conversion factor of .0027). Even though dissolved-solids *concentrations* are generally higher during periods of low streamflow than of high streamflow, the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

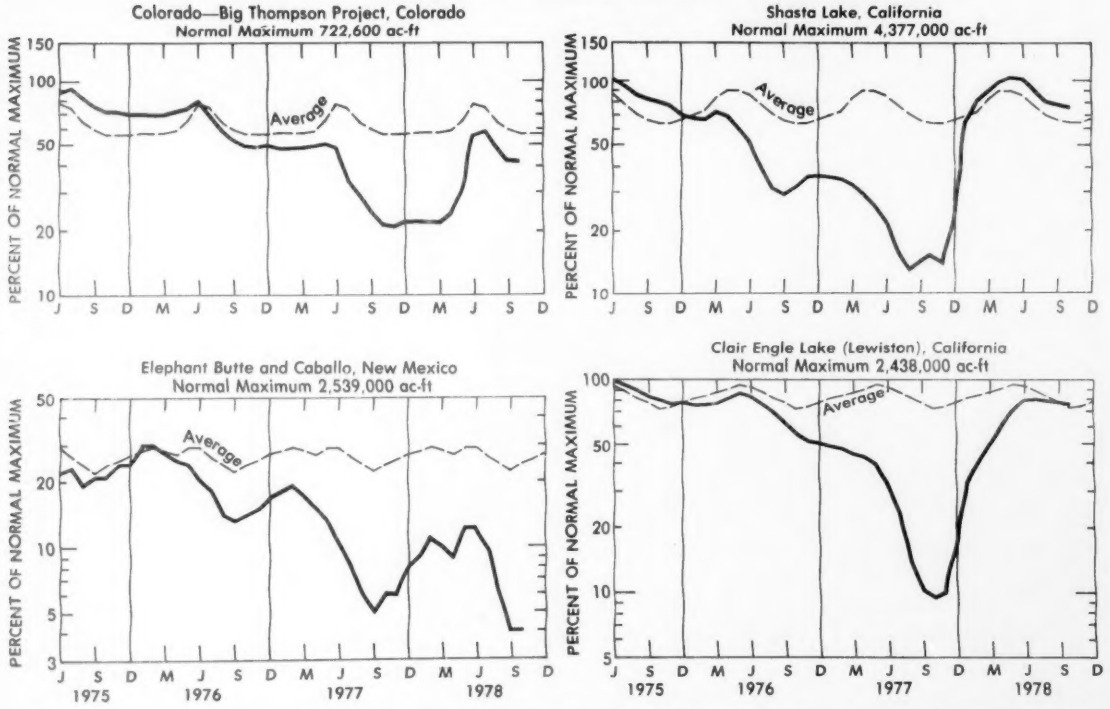
Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR OCTOBER AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	October data of following calendar years	Stream discharge during month	Dissolved-solids concentration during month[a]		Dissolved-solids discharge during month[a]			Water temperature during month[b]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean	Minimum	Maximum	Mean, in °C	Minimum, in °C	Maximum, in °C
						(tons per day)					
	NORTHEAST										
01463500	Delaware River at Trenton, N.J.	1978	4,140	109	135	1,360	1,170	1,890	16.0	13.5	19.0
		1944–77	6,749	58	156	.....	463	8,300	....	8.5	25.5
	(Morrisville, Pa.)	(Extreme yr)		(1945)	(1953)		(1963)	(1955)			
			[c]4,025								
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, N.Y.	1978	263,000	166	167	118,000	115,000	121,000	12.5	11.5	15.0
		1975–77	297,300	166	168	134,000	127,000	138,000	13.0	0	16.0
		(Extreme yr)		(1976)	(1975, 1977)		(1975)	(1977)			
	median streamflow at Ogdensburg, N.Y.		[c]234,500								
	SOUTHEAST										
07289000	Mississippi River at Vicksburg, Miss.	1978	292,700	204	282	198,000	171,000	222,000	21.0	18.0	26.0
		1975–77	405,100	192	271	247,000	117,000	338,000	20.0	15.0	25.0
		(Extreme yr)		(1975)	(1976)		(1976)	(1975)			
			[c]264,200								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam 53, near Grand Chain, Ill. (25 miles west of Paducah, Ky.; streamflow station at Metropolis, Ill.)	1978	84,200	159	269	.....	18,700	101,000	....	17.0	24.5
		1954–77	116,300	135	330	.....	15,000	262,000	....	12.0	26.0
		(Extreme yr)		(1960, 1963)	(1967)		(1973)	(1976)			
			[c]89,100								
	MIDCONTINENT										
06934500	Missouri River at Hermann, Mo. (60 miles west of St. Louis, Mo.)	1978	67,800	387	446	77,700	72,400	83,200	16.0	13.0	20.0
		1975–77	72,500	236	459	74,100	51,800	142,000	15.5	10.0	22.0
		(Extreme yr)		(1977)	(1976)		(1976)	(1975)			
			[c]55,340								
	WEST										
14128910	Columbia River at Warrendale, Oreg. (streamflow station at The Dalles, Oreg.)	1978	129,600	91	97	32,900	18,200	43,900	16.0	14.0	17.0
		1975–77	117,200	78	117	30,500	18,400	48,900	16.0	14.0	19.5
		(Extreme yr)		(1976)	(1977)		(1977)	(1975)			
			[c]100,400								

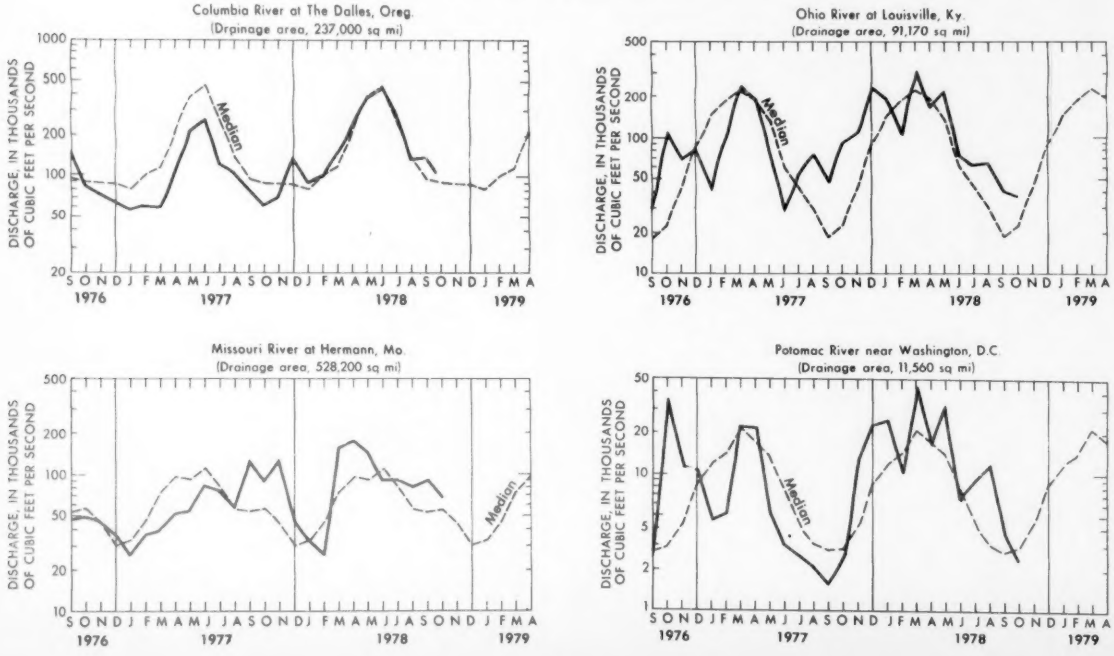
[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data for current month.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1975 TO OCTOBER 1978



Near or above-average contents characterized most reservoirs in the West during October. However, selected reservoir systems in Colorado and New Mexico remained far below average. (See graphs above.)

HYDROGRAPHS OF FOUR LARGE RIVERS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF OCTOBER 1978

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Sept. 1978	End of Oct. 1978	End of Oct. 1977	Average for end of Oct.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	37	32	78	33	226,300 (a)
QUEBEC					
Allard (P)	75	84	94	65	280,600 ac-ft
Gouin (P)	63	63	79	55	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	59	49	89	51	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	75	38	79	75	3,330 mcf
Lake Francis (FPR)	71	87	89	76	4,326 mcf
Lake Winnipesaukee (PR)	66	57	92	54	7,200 mcf
VERMONT					
Harriman (P)	66	52	78	60	5,060 mcf
Somerset (P)	68	73	91	68	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	73	67	82	71	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	56	49	84	56	34,270 mcf
Indian Lake (FMP)	94	94	105	53	4,500 mcf
New York City reservoir system (MW)	75	65	96	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	66	53	61	64	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	41	41	44	31	51,400 mcf
Pymatuning (FMR)	89	87	89	77	8,191 mcf
Raystown Lake (FR)	66	65	67	44	33,190 mcf
Lake Wallenpaupack (PR)	62	60	46	47	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	93	87	69	84	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	90	84	91	80	12,580 mcf
Narrows (Badin Lake) (P)	93	96	94	96	5,617 mcf
High Rock Lake (P)	67	50	91	58	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	80	81	80	60	70,300 mcf
Lakes Marion and Moultrie (P)	79	70	84	64	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	64	53	64	53	75,360 mcf
GEORGIA					
Burton (PR)	91	94	82	65	104,000 ac-ft
Sinclair (MPR)	78	80	74	71	214,000 ac-ft
Lake Sidney Lanier (FMPR)	53	45	54	49	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	86	82	83	65	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	35	30	42	33	1,156,000 cfsd
Douglas Lake (FPR)	24	17	32	23	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	57	46	56	48	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	42	37	52	38	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	53	45	52	47	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	96	94	95	75	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	91	86	79	61	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	41	36	28	29	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	93	90	77	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	91	91	50	72	127,600 ac-ft
Bell Fourche (I)	43	48	27	35	185,200 ac-ft
Lake Francis Case (FIP)	76	67	60	56	4,834,000 ac-ft
Lake Oahe (FIP)	90	85	70	.....	22,530,000 ac-ft
***MIDCONTINENT REGION*--Continued**					
SOUTH DAKOTA--Continued					
Lake Sharpe (FIP)	100	104	102	92	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	93	96	97	95	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	58	60	64	67	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	79	77	88	83	2,378,000 ac-ft
Keystone (FPR)	73	74	89	88	661,000 ac-ft
Tenkiller Ferry (FPR)	90	87	96	89	628,200 ac-ft
Lake Altus (FIMR)	42	43	69	47	134,500 ac-ft
Lake O'The Cherokees (FPR)	76	71	85	81	1,492,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	87	84	91	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	41	38	76	44	386,400 ac-ft
Canyon (FMR)	102	96	91	67	385,600 ac-ft
International Amistad (FIMPW)	106	129	94	76	3,497,000 ac-ft
International Falcon (FIMPW)	78	94	90	76	2,667,000 ac-ft
Livingston (IMW)	82	80	95	72	1,788,000 ac-ft
Possum Kingdom (IMPRW)	96	95	87	102	569,400 ac-ft
Red Bluff (PI)	30	30	6	28	307,000 ac-ft
Toledo Bend (P)	89	87	78	73	4,472,000 ac-ft
Twin Buttes (FIM)	62	61	75	23	177,800 ac-ft
Lake Kemp (IMW)	56	56	67	88	268,000 ac-ft
Lake Meredith (FMW)	36	35	39	39	821,300 ac-ft
Lake Travis (FIMPRW)	72	68	76	79	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	100	86	77	85	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	98	89	95	99	5,232,000 ac-ft
Lake Chelan (PR)	95	82	67	73	676,100 ac-ft
Lake Cushman	96	91	84	86	359,500 ac-ft
Lake Merwin (P)	101	95	105	84	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	59	58	16	48	1,235,000 ac-ft
Coeur d'Alene Lake (P)	78	58	60	54	238,500 ac-ft
Pend Oreille Lake (FP)	92	55	64	72	1,561,000 ac-ft
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	69	68	19	50	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	92	88	61	83	802,000 ac-ft
Buffalo Bill (IP)	84	76	43	75	421,300 ac-ft
Keyhole (F)	80	79	57	40	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	50	50	38	42	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	12	364,400 ac-ft
Taylor Park (IR)	62	55	42	53	106,200 ac-ft
Colorado–Big Thompson project (I)	43	42	21	56	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	68	67	62	.....	31,620,000 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	68	67	54	57	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	72	63	14	53	1,000,000 ac-ft
Hetch Hetchy (MP)	93	80	29	47	360,400 ac-ft
Isabella (FIR)	68	56	6	22	551,800 ac-ft
Pine Flat (FI)	74	65	7	35	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	77	75	9	71	2,438,000 ac-ft
Lake Almanor (P)	88	82	52	47	1,036,000 ac-ft
Lake Berryessa (FIMW)	70	69	47	75	1,600,000 ac-ft
Millerton Lake (FI)	76	55	37	31	503,200 ac-ft
Shasta Lake (FIPR)	79	77	15	64	4,377,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	19	14	0	49	744,600 ac-ft
NEVADA					
Rye Patch (I)	29	24	22	53	194,300 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	80	81	77	68	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	7	7	2	12	1,073,000 ac-ft
Salt and Verde River system (IMPR)	71	70	24	34	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	23	23	31	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	4	4	6	24	2,539,000 ac-ft

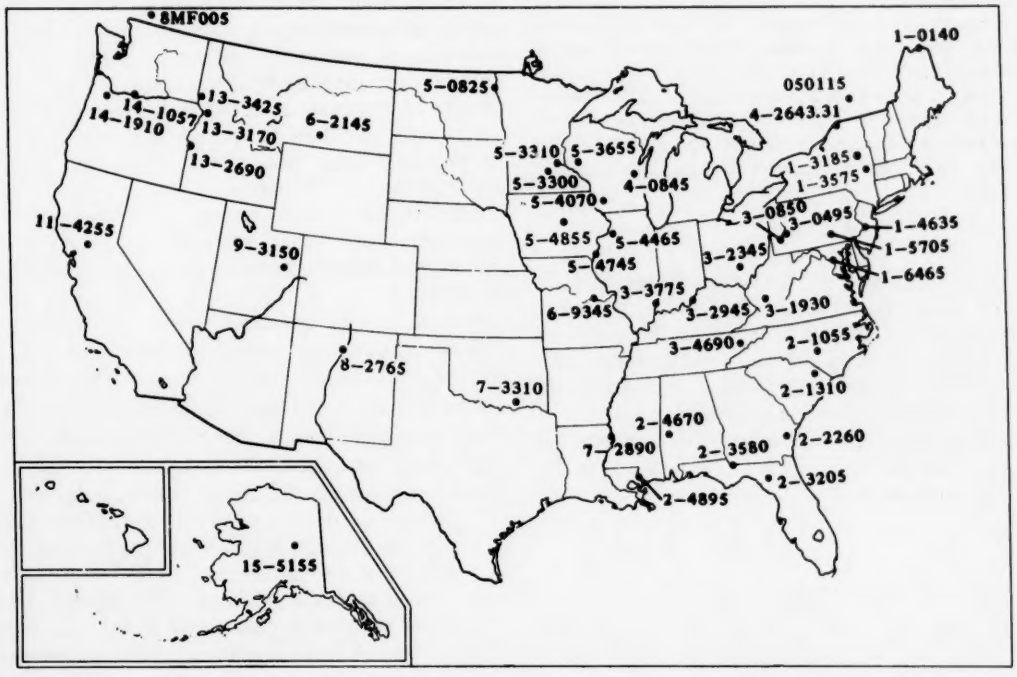
[a]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

FLOW OF LARGE RIVERS DURING OCTOBER 1978

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	October 1978					
				Monthly discharge (cfs)	Percent of median monthly discharge, 1941–70	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine	5,690	9,397	2,767	59	+1	3,600	2,300	31
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	1,429	119	+62	1,800	1,160	31
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	2,536	111	+33	3,500	2,300	31
1–4635	Delaware River at Trenton, N.J	6,780	11,360	4,001	99	-6	4,110	2,660	24
1–5705	Susquehanna River at Harrisburg, Pa	24,100	33,670	11,010	140	+2	11,300	7,300	25
1–6465	Potomac River near Washington, D.C	11,560	[1] 10,640	2,410	85	-36	2,340	1,510	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C	4,810	4,847	823	39	-41	670	430	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	3,160	68	-31	3,150	2,040	26
2–2260	Altamaha River at Doctortown, Ga	13,600	13,380	2,410	46	-28	2,150	1,390	30
2–3205	Suwannee River at Branford, Fla	7,740	6,775	2,930	64	-25	2,720	1,760	31
2–3580	Apalachicola River at Chattahoochee, Fla	17,200	21,690	10,000	92	-21	8,690	5,620	31
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala	15,400	21,700	1,364	51	-35	1,050	680	25
2–4895	Pearl River near Bogalusa, La	6,630	8,533	2,122	107	-7	1,470	950	31
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	7,865	180	+93	7,790	5,030	24
3–0850	Monongahela River at Braddock, Pa	7,337	[1] 11,950	3,360	107	-33	3,050	1,970	24
3–1930	Kanawha River at Kanawha Falls, W.Va	8,367	12,370	3,679	81	0	2,350	1,520	25
3–2345	Scioto River at Higby, Ohio	5,131	4,337	1,719	295	+28	1,290	830	26
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	37,800	168	-9	22,800	14,700	25
3–3775	Wabash River at Mount Carmel, Ill	28,600	26,310	9,804	192	-38	9,000	5,800	31
3–4690	French Broad River below Douglas Dam, Tenn	4,543	[1] 6,528	1,196	34	-57	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis[2]	6,150	4,142	4,043	190	-36	.....	.....	.....
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y[3]	299,000	239,100	263,300	112	-4	258,000	167,000	31
050115	St. Maurice River at Grand Mere, Quebec	16,300	24,900	16,200	89	+56	19,700	12,700	31
5–0825	Red River of the North at Grand Forks, N. Dak	30,100	2,439	859	63	-11	800	520	31
5–3300	Minnesota River near Jordan, Minn	16,200	3,306	758	79	-26	560	360	25
5–3310	Mississippi River at St. Paul, Minn	36,800	[1] 10,230	8,840	141	-36	8,080	5,220	25
5–3655	Chippewa River at Chippewa Falls, Wis	5,600	5,062	4,819	186	-30	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	9,192	168	-25	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	5,890	244	-6	4,450	2,880	31
5–4745	Mississippi River at Keokuk, Iowa	119,000	61,210	52,735	166	-33	37,500	24,200	31
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa	9,879	3,796	2,693	299	-61	1,940	1,250	31
6–2145	Yellowstone River at Billings, Mont	11,796	6,754	5,315	134	-22	4,200	2,700	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	67,690	122	-25	66,000	42,700	27
7–2890	Mississippi River at Vicksburg, Miss[4]	1,144,500	552,700	292,700	111	-16	230,000	149,000	31
7–3310	Washita River near Durwood, Okla	7,202	1,379	87	17	-47	85	55	31
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex	9,730	732	401	141	+87	450	290	31
9–3150	Green River at Green River, Utah	40,600	6,369	1,511	61	-18	1,800	1,200	31
11–4255	Sacramento River at Verona, Calif	21,257	18,370	10,570	120	-33	9,800	6,300	27
13–2690	Snake River at Weiser, Idaho	69,200	17,670	13,550	93	-5	13,100	8,470	29
13–3170	Salmon River at White Bird, Idaho	13,550	11,060	5,063	103	-23	4,830	3,120	30
13–3425	Clearwater River at Spalding, Idaho	9,570	15,320	3,314	87	-64	2,780	1,800	29
14–1057	Columbia River at The Dalles, Oreg[5]	237,000	194,000	99,300	108	-29	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	5,866	80	-34	11,500	7,430	27–31
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	15,135	93	-44	12,000	7,800	31
8MF005	Fraser River at Hope, British Columbia	83,800	95,300	73,000	96	-21	69,800	45,100	30

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 16.

WATER RESOURCES REVIEW

October 1978

Based on reports from the Canadian and U.S. field offices; completed November 16, 1978

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for October based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for October 1978 is compared with flow for October in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for October is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the October flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of October. Water level in each key observation well is compared with average level for the end of October determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of September to the end of October.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

SUMMARY APPRAISALS OF THE NATION'S GROUND-WATER RESOURCES—HAWAII REGION

The abstract and illustrations below are from the report, *Summary appraisals of the Nation's ground-water resources—Hawaii Region,* by K. J. Takasaki: U.S. Geological Survey Professional Paper 813 M, 29 pages, 1978. This report may be purchased for $1.50 from Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 (check or money order payable to U.S. Geological Survey); or from Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (payable to Superintendent of Documents).

ABSTRACT

The water resources of the Hawaii Region (fig. 1), taken as a whole, are far greater than foreseeable future demands on them, but this is not so for the individual islands. Each and every island is independent with respect to water supply, and the occurrence and availability of water vary widely from island to island.

The ground-water resources offer better prospects for supplying additional water needs in the future than the surface-water resources. Most of the surface supplies that are easy to develop have been fully utilized where needed, and conduits and reservoirs necessary to develop new or additional supplies would generally require large and perhaps prohibitive outlays of capital. In 1975, ground water supplied 46 percent, and surface water 54 percent of the water needs but, in the years ahead, these percentages will likely be reversed as more ground-water development takes place. Total water use, in 1975, averaged about 1,775 million gallons per day, of which about 810 million gallons per day was ground water. The total water use is divided into public supply, 11 percent; self-supplied industrial use, 23 percent; and agricultural, 66 percent.

Rainfall is the principal source of ground-water recharge. Local mean annual rainfall ranges from less than 20 inches to more than 300 inches, with the annual average rainfall on the large islands exposed to the trade winds being slightly more than 73 inches and that on the small islands situated in the rain shadow of the larger islands being less than 26 inches. Ground-water recharge has been estimated at about 2,400 billion gallons per year (6.5 billion gallons per day) or roughly 30 percent of the rainfall.

Most fresh ground water in the region is stored below sea level in porous lava flows, much of it as basal-water lenses floating on saline ground water, as distinguished from dike-impounded water in the interior of the islands. (See fig. 2.) The basal-water lens is maintained by recharge, which, if reduced, leads to thinning of the lens and subsequent encroachment of seawater. Seawater is the biggest pollutant of freshwater, and many of the ground-water problems are, in some way, associated with the encroachment of saline water induced by development.

The major problem areas include the entire island of Oahu, south Kohala-Kona coast on the island of Hawaii, Lahaina District in Maui, and the Koloa and Kekaha-Mana areas in Kauai.

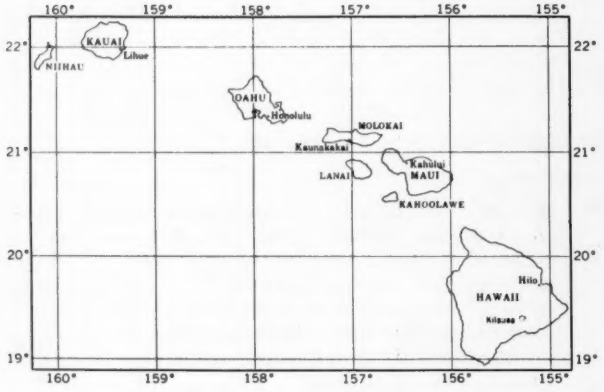

Figure 1.—Hawaii Region.

Reference: Cox, D. C., 1954, Water development for Hawaiian sugarcane irrigation: The Hawaiian Planters' Rec., v. 54, p. 175–197.

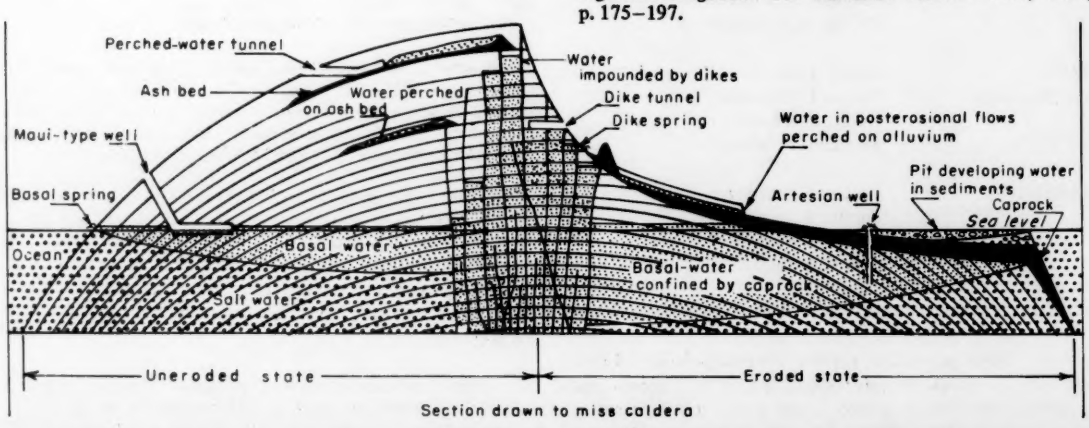

Figure 2.—Occurrence and development of ground water in an idealized Hawaiian volcanic dome (from Cox, 1954).